

Red Line/Blue Line Connector Project

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Massachusetts

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Introduction and Methodology

This Traffic Technical Memorandum evaluates the environmental consequences (direct, indirect, and cumulative effects) of the proposed Red Line/Blue Line Connector Project with respect to intersection and roadway traffic operations, pedestrian and bicycle accommodations, construction, and parking in the study area. With the exception of construction impacts, the evaluation is based on an assumed design year of 2030.

The Secretary of the Executive Office of Energy and Environmental Affairs (EOEEA) issued a certificate on the Expanded Environmental Notification Form (EENF) on November 15, 2007. The Secretary's Certificate included a number of requirements for the Draft EIR. This technical report addresses the following specific requirements for traffic:

- A traffic impact study for three conditions: No-Build, Blue Line Extension to Charles/MGH Station with elimination of Bowdoin Station, and Blue Line Extension to Charles/MGH Station with relocated Bowdoin Station.
- An evaluation of the project's potential impact for intersection Level of Service (LOS) and pedestrian and bicycle circulation.
- Proposed mitigation for areas where the project will have significant impact on traffic, pedestrian or bicycle operations.
- Proposed temporary mitigation and detours to address construction-related impacts.

The following chapters discuss the methodology used for forecasting future traffic volumes throughout the Study Area (both with and without Bowdoin Station), analyzing the impacts of the project on the transportation system in the surrounding neighborhoods, and identifying measures that would mitigate the project impacts. Chapter 2 describes future No-Build and Build traffic conditions and summarizes impacts that would be anticipated under each alternative. Chapter 3 summarizes the construction impacts and potential mitigation measures needed within the study area to maintain traffic during construction.

1.1 Methodology

The following provides a summary of the methods used to identify the environmental consequences related to transportation, including vehicular traffic, pedestrians, bicycles, construction, and parking. The analysis in this technical report conforms to the *Guidelines for EIS/EIR Traffic Impact Assessment*¹.

1.1.1 Vehicular Transportation

Methods used for this study followed standard transportation planning industry practice for the evaluation of transportation systems and infrastructure. Much of the evaluation was based on a 2030 traffic forecast with and without the proposed project provided by the Central Transportation Planning Staff (CTPS). CTPS is the staff for the metropolitan planning organization for the Boston region and works with the communities within the region to address issues such as transportation, land use, and economic development. The CTPS regional travel demand model was used to provide the traffic forecasts for the entire Study Area. This model is run using TransCAD software.

CTPS's method of travel demand forecasting follows the traditional four steps of trip generation, trip distribution, mode share, and travel assignment. The model uses changes in population, number of households, employed residents, number of automobiles, and total employment to forecast changes in traffic over time. Key points of the forecasting method are summarized below. The *Ridership Technical Memorandum* summarizes the methods used to forecast travel demand.

- The CTPS regional travel demand model was calibrated to 2009 conditions using the existing condition assessment presented in Section 4.5 of the Draft EIR. This produced an existing baseline condition in the model that approximates empirical traffic counts and traffic operations.
- A future No-Build (2030) model run was prepared based on the forecasted changes in population, households, employed residents, and total automobiles in the Greater Boston region. Specific attention was paid to the forecasted changes in the Beacon Hill and West End neighborhoods of Boston, which have the greatest affect on future traffic volumes. The model was also updated to reflect anticipated changes to the transportation infrastructure, including projects on the Transportation Improvement Plan (TIP) and long-range regional plans.
- Using the future No-Build model run, weekday morning and evening peak hour turning movement volume networks were developed. The resulting peak hour volumes were used as inputs into a traffic operations model used to evaluate how well the future infrastructure would accommodate the demands placed on

¹ Executive Office of Energy & Environmental Affairs and Executive Office of Transportation and Construction, *Guidelines for EIS/EIR Traffic Impact Assessment*, July, 1989.

it. The model assigns a level of service (LOS) rating to each facility analyzed that is similar to a report card – LOS A (under capacity, little delay) to LOS F (over capacity, excessive delays). This traffic operations analysis, or level of service evaluation, is consistent with the Highway Capacity Manual² (HCM) which is the industry-wide guideline for transportation assessments. The level of service assessment was prepared for all Study Area intersections.

- Future Build model runs for the two proposed alternatives were prepared by including the extended Blue Line as a mode choice and quantifying the number of vehicle trips expected to change mode from passenger car to transit service. Using the Build model runs, peak hour turning movement volumes were developed for each alternative.
- The peak hour volumes were then used to conduct level of service assessments for the Build conditions. When compared to the No-Build Alternative, the level of service assessment for the Build alternatives show the effect of the proposed action, both beneficial and detrimental.
- Measures to improve conditions and avoid or minimize impacts on the transportation network were identified and evaluated for effectiveness.
- Where impacts could not be avoided or minimized, mitigation was proposed and evaluated for effectiveness. Mitigation was proposed for intersections where LOS E/F conditions resulted because of the Build Alternatives and where LOS E/F conditions under the No-Build Alternative were notably worsened (generally an increase in control delay of more than 10 seconds).

As described Appendix A, level of service is based on delay at signalized and unsignalized intersections. The criteria established to define levels of service can be found in Table 4.6-2 of that section.

1.1.2 Pedestrians and Bicycles

The travel demand model was also used to establish pedestrian patterns throughout the study area as they relate to the Project. For each applicable transportation analysis zone (TAZ) within the regional model, CTPS was able to provide the number of pedestrians using transit and the specific station they would access (Charles/MGH, Bowdoin, or Government Center). Each pathway of travel was mapped and pedestrians were accordingly assigned to routes. A pedestrian level of service analysis was completed to determine the expected delay to pedestrians at study area intersections (i.e. how long a pedestrian has to wait at a traffic signal before getting a “Walk” indication to cross the street). For signalized intersections, pedestrian level of service is based on traffic signal timings. At unsignalized intersections, where motorists are required to yield the right-of-way to pedestrians in a crosswalk, pedestrian delays are expected to be minor and are not quantified. The

² 2000 Highway Capacity Manual, Special Report 209, Transportation Research Board, Washington DC, 2000.

analysis focuses on the Charles/MGH, Bowdoin, and Government Center areas because these stations would be directly affected by changes in pedestrian or bicycle patterns caused by the proposed project. Pedestrian and bicycle access and demand at other stations along the Blue Line would be unchanged or see a reduction (in the station area only) in the total number of pedestrians transferring from one subway line to another.

In addition to the pedestrian level of service analysis, a secondary analysis was completed to determine whether sufficient crossing times were provided at traffic signals (i.e. whether or not there is enough time provided for the pedestrian to physically cross the street before the flashing “Don’t Walk” signal ends), whether existing crosswalks were sufficient to accommodate projected pedestrian volumes and travel patterns, and whether either alternative would be likely to result in an adverse impact to pedestrians. Pedestrian volume networks for all Project Alternatives can be found in Appendix A.

The methodology used for evaluating the impacts on bicycle transportation by each alternative involved documenting the existing and potential future bicycle facilities in the vicinity of the proposed station locations. Bicycle accommodations were evaluated qualitatively for the Build alternatives with respect to their ability to serve projected users and any projected impacts from project related traffic and planned or proposed roadway improvements.

1.1.3 Construction

The methodology for the construction assessment identifies measures taken to ensure the maintenance of two through lanes for traffic at all times in all areas to the greatest extent possible. The analysis includes the impacts to parking along Cambridge Street during each phase of construction, changes in traffic operations (levels of service) and traffic volumes which may be caused by construction, the potential for impacts to emergency vehicle access, and an overview of the preliminary Traffic Management Plan. Also evaluated for each phase of construction are pedestrian facilities and access to abutting properties that would be impacted within the Study Area in support of construction of the proposed alternative. Every effort was made to minimize anticipated impacts or disruptions while providing a reasonable work area for the proposed construction anticipated.

The potential for traffic diversions during construction is also discussed. However, the selection of mined construction alternatives rather than cut and cover construction greatly reduces the need to close Cambridge Street and the likelihood of traffic diversion.

1.1.4 Parking

The methodology for the parking assessment identifies the number of parking spaces (by alternative) that would be removed from the study area in support of the proposed alternative. The reason for the parking reduction, whether to support construction (temporary) or needed traffic mitigation (permanent), is also identified.

1.2 Existing Conditions Summary

The existing conditions analysis of the affected environment Study Area is provided in Appendix A to this technical memorandum. The existing conditions assessment for the Study Area evaluated traffic, pedestrian and bicycle operations and safety statistics at 10 intersections along Cambridge Street. A comprehensive parking supply and regulation inventory was also completed along Cambridge Street and intersecting streets. As required by the Secretary's Certificate on the EENF, a meeting was convened between representatives of the Department of Conservation and Recreation (DCR), the Massachusetts Department of Transportation (MassDOT), and the City of Boston Transportation Department (BTD) to discuss Study Area roadways and intersections. At that meeting, ten intersections were selected for the existing conditions evaluation:

- Charles Circle - Longfellow Bridge outbound/Storrow Drive westbound off-ramp (unsignalized with flashing red and yellow signals);
- Charles Circle - Charles Street/Storrow Drive eastbound off-ramp/Longfellow Bridge inbound (signalized);
- Charles Circle - Charles Street northbound/Storrow Drive westbound on-ramp (signalized);
- North Grove Street/Grove Street (signalized);
- North Anderson Street/ Anderson Street (unsignalized);
- Blossom Street/Garden Street (signalized);
- Joy Street (signalized with fire pre-emption);
- Staniford Street/Temple Street (signalized);
- New Chardon Street/Bowdoin Street (signalized); and
- New Sudbury Street/Somerset Street (signalized).

A map showing the locations of these intersections is also provided in Appendix A.

1.2.1 Summary of Findings

The results of the existing conditions assessment reveal the following:

- Charles Circle is currently ranked 43 on the MassHighway Top 1,000 High Crash Location list and exceeds the District 4 and Statewide average crash rates.

- Four signalized intersections and two unsignalized intersection currently operate at unacceptable levels of service during at least one peak hour.
- Pedestrians currently experience high delay at five of the signalized intersections within the Study Area.
- Heavy bicycle volumes were observed on Cambridge Street.
- During field observations, it was observed that resident parking spaces and metered parking spaces are fully occupied during the midday and mostly occupied in the evening.

2

Design Year Project Impact Analysis

As described in the Definition of Alternatives Report,³ the Build Alternatives under consideration include eliminating or relocating the Bowdoin Station. A new underground platform for the Blue Line would be constructed below and to the east of the existing Charles/MGH Station headhouse and elevated platform for the Red Line. Connections between the two platform levels would be made via stairways, escalators and elevators. The CTPS travel demand model was used to estimate changes in traffic and pedestrian patterns for the Build alternatives. The model results indicate that there would be a negligible difference in traffic operations between the two alternatives.

The following sections describe the potential adverse or beneficial impacts to transportation that would result from the Build Alternatives. The No-Build Alternative is also described as a baseline condition to which the operational alternatives may be compared.

Each Build Alternative would have both direct and indirect impacts. Direct impacts are a direct consequence of the alternative, such as altered traffic demands from changes in the roadway system or increased traffic demands that result from the volume of traffic and the amount of parking available for each alternative. Reasonably foreseeable impacts are directly caused by the action but occur later in time or farther removed in distance. Indirect impacts include induced traffic shifts from other roadways to access stations because of the proposed changes.

Once individual impacts are identified, cumulative impacts can also be discussed. Cumulative impacts account for the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individual, minor actions that collectively constitute a significant action. Since the CTPS model was used to forecast traffic for the No-Build and Build

³ EOT. 2009. *Red Line-Blue Line Connector Project- Definition of Alternatives Report*. Commonwealth of Massachusetts, Executive Office of Transportation and Public Works. Prepared by Vanasse Hangen Brustlin, Inc.: Boston.

Alternatives, direct, indirect, and cumulative effects are inherently incorporated in the analyses.

Each Build Alternative is expected to have temporary impacts resulting from construction. These impacts are discussed in Chapter 3.

2.1 No-Build Alternative

This section describes the transportation impacts of the No-Build Alternative on the roadway, pedestrian, and bicycle systems in the study area. The impacts of the Build Alternatives are compared to the No-Build Alternative. The No-Build Alternative includes planned or on-going physical and operational transportation changes that would occur between 2009 and 2030.

2.1.1 Physical Changes

Physical changes include any roadway reconstruction planned or anticipated to occur within the Study Area by 2030 that would change the capacity of roadways in the area. Reconstruction of Cambridge Street was completed in 2007 and no further changes are planned. The Longfellow Bridge will be reconstructed over the next several years and will include bike lanes and wider sidewalks for pedestrians. However, no change to vehicle capacity is anticipated. Therefore, no physical changes to the roadway infrastructure were included for the No-Build condition.

2.1.2 Operational Changes

Operational changes include changes in traffic demands attributed to forecasted changes in population, households, and employment; changes to traffic patterns or traffic signal coordination; and changes to the transit system. The operational changes described below were provided by the Metropolitan Area Planning Council (MAPC) and are reflective of their ongoing regional planning efforts with the Boston Redevelopment Authority (BRA) and Boston Transportation Department (BTD).

2.1.2.1 Transportation Projects

In addition to traffic growth and consistent with MAPC's long range Transportation Plan, the following transportation projects are included in the CTPS travel demand forecast for 2030:

- Fairmont commuter rail line improvements
- Fitchburg commuter rail line improvements

- Extension of Green Line service from Lechmere to Medford and Somerville (Union Square)
- 500 additional parking spaces at the Blue Line Wonderland T Station
- 500 additional parking spaces at the Beverly commuter rail station
- 500 additional parking spaces at the Salem commuter rail station
- Route 28X bus service
- Completion of the Assembly Square Development and new Orange Line station
- Completion of Russia Wharf
- Improved Silver Line service from Dudley to Temple via Essex and Kneeland Streets (*note: this service improvement was initiated in November 2009*)

2.1.3 Traffic Operations

A traffic operations analysis was performed for the No-Build conditions based on the methodology described in Section 4.5 of the Draft EIR, *Traffic*. The results of this analysis are presented in Table 2-1 for signalized intersections and Table 2-2 for unsignalized intersections. Complete level of service results for all intersections are provided in Appendix A. No-Build 2030 traffic volumes are shown on Figure 2-1.

Three signalized intersections and two unsignalized intersections operate at an unacceptable level of service during at least one peak hour in 2009 and are projected to continue to operate at unacceptable levels under the 2030 No-Build Condition. By 2030, the intersection of Cambridge Street at New Chardon Street/Bowdoin Street is expected to decline from LOS D to LOS E during the evening peak hour under No-Build conditions. No other additional deficiencies are expected.

Table 2-1 No-Build Condition Signalized Intersection Traffic Operations (2030)

Intersection	Time of Day	Existing Conditions			No-Build Conditions		
		V/C ¹	Delay ²	LOS ³	V/C	Delay	LOS
Charles Circle - Charles Street/Storrow Drive	Morning	0.60	22	C	0.64	22	C
Westbound On-Ramp	Evening	0.75	18	B	0.77	18	B
Charles Circle - Charles Street/Storrow Drive	Morning	1.11	81	F	1.11	80	F
Eastbound Off-Ramp/Longfellow Bridge Inbound	Evening	1.00	72	E	1.03	85	F
Cambridge Street and	Morning	1.10	26	C	1.05	26	C
North Grove Street/Grove Street	Evening	0.89	12	B	0.89	13	B
Cambridge Street and	Morning	0.66	15	B	0.66	15	B
Blossom Street/Garden Street	Evening	0.65	14	B	0.75	18	B
Cambridge Street and Joy Street	Morning	0.48	8	A	0.48	8	A
	Evening	0.48	8	A	0.57	8	A
Cambridge Street and	Morning	0.82	37	D	0.83	38	D
Stanford Street/Temple Street	Evening	0.70	35	C	0.84	48	D
Cambridge Street and	Morning	0.73	57	E	0.73	72	E
New Chardon Street/Bowdoin Street	Evening	0.78	48	D	0.98	56	E
Cambridge Street and	Morning	0.80	110	F	0.80	114	F
New Sudbury Street/Somerset Street	Evening	0.82	53	D	0.87	54	D

1 Volume-to-capacity ratio

2 Average delay expressed in seconds per vehicle

3 Level-of-Service

Table 2-2 No-Build Condition Unsignalized Intersection Traffic Operations (2030)

Intersection	Time of Day	Critical Movement	Existing Conditions			No-Build Conditions		
			v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS
Charles Circle – Cambridge Street/	Morning	SB T	0.86	62	F	0.88	67	F
Storrow Drive Westbound Off-Ramp	Evening	SB T	0.52	23	C	0.68	33	D
Cambridge Street and	Morning	SB R	0.28	25	C	0.28	25	C
North Anderson Street/ Anderson Street	Evening	SB R	>1.20	>120	F	>1.20	>120	F

1 Volume-to-capacity ratio

2 Average delay expressed in seconds per vehicle

3 Level-of-Service

2.1.4 Emergency Access and Truck Routes

The No-Build alternative would not physically change emergency access or truck routes in the Study Area.

2.1.5 Pedestrians and Bicycles

Pedestrian level of service at signalized intersections is a function of the traffic signal timing and phasing. Because traffic signal timing and phasing is assumed to be unchanged from existing conditions in the No Build Alternative, pedestrian level of service would remain the same as presented in Appendix A (Table 4.5-7).

2.1.6 Parking

The No Build Alternative would not physically alter the existing parking supply or the City's ability to modify parking or change enforcement.

2.2 Alternative 1

Alternative 1 would extend the Blue Line to Charles/MGH Station and eliminate Bowdoin Station. This alternative would require the realignment of the tracks from the Government Center Station to the existing Bowdoin Station and the construction of new tracks from this point to Charles/MGH Station. Alternative 1 would also require a new subsurface platform for the Blue Line below and to the east of the Charles/MGH Station headhouse. Accessible pedestrian connections between the proposed Blue Line Station and the street and elevated Red Line platforms would be provided. The elimination of Bowdoin Station allows for faster travel time on the Blue Line between Government Center and Charles/MGH than if the station was maintained.

Table 2-3 presents the expected daily Red Line and Blue Line ridership under Alternative 1 (as compared to the No-Build).

Table 2-3 Projected Alternative 1 Station Activity

	No-Build (2030)			Alternative 1		
	Daily Boardings	Walk-Ins	Transfers	Daily Boardings	Walk-Ins	Transfers
Bowdoin Station	1,450	1,450	0	No Service	No Service	No Service
Charles/MGH Station	10,050	10,050	0	22,390	11,170	11,220
Red Line	10,050	10,050	0	12,920	7,310	5,610
Blue Line	No Service	No Service	No Service	9,470	3,860	5,610

Source: CTPS

A detailed ridership discussion and analysis is provided in the *Ridership Technical Memorandum*.

Build 2030 traffic volumes are shown on Figure 2-2. During the morning peak hour, Alternative 1 would reduce traffic volume on Cambridge Street by about 25 vehicles per direction west of Blossom Street. East of Blossom Street, Alternative 1 would reduce eastbound traffic by about 30 vehicles and westbound traffic by about 15 vehicles. During the evening peak hour, west of Blossom Street Alternative 1 would reduce traffic volume on Cambridge Street by about 15 vehicles in the eastbound direction and 50 vehicles in the westbound direction. East of Blossom Street, Alternative 1 would reduce evening peak hour traffic volumes by about 30 to 50 vehicles eastbound. Westbound traffic would realize a reduction of about 5 vehicles during the evening peak hour.

2.2.1 Traffic Operations

Traffic operations along Cambridge Street would remain essentially unchanged under Alternative 1. The majority of intersections would see minor improvements to overall average intersection delay. Table 2-4 presents the signalized traffic operations results for Alternative 1.

The average delay at one intersection, Cambridge Street at New Sudbury/Somerset Street would increase by about two seconds during the morning peak hour under Alternative 1. This increase is not a result of the proposed alternative, but rather a reflection of the change in distribution of traffic at this intersection. Despite the calculated increase in overall intersection delay, the intersection of Cambridge Street and New Sudbury/Somerset Street would see an overall reduction in the number of trips expected (about 40 fewer during the morning peak hour and 35 fewer during the evening peak hour) when comparing No-Build to Alternative 1.

Table 2-5 presents the results of the unsignalized intersection analysis. Charles Circle is expected to see a slight improvement in delay when compared to the No-Build condition. This is a direct reflection of decreased through traffic volumes along Cambridge Street destined to the Longfellow Bridge.

Table 2-4 Alternative 1 Signalized Intersection Traffic Operations

Intersection	Time of Day	No-Build Conditions			Alternative 1		
		V/C ¹	Delay ²	LOS ³	V/C	Delay	LOS
Charles Circle - Charles Street/Storrow Drive	Morning	0.64	22	C	0.62	22	C
Westbound On-Ramp	Evening	0.77	18	B	0.75	18	B
Charles Circle - Charles Street/Storrow Drive	Morning	1.11	80	F	1.10	79	E
Eastbound Off-Ramp/Longfellow Bridge Inbound	Evening	1.03	85	F	1.02	83	F
Cambridge Street and	Morning	1.05	26	C	1.05	26	C
North Grove Street/Grove Street	Evening	0.89	13	B	0.89	12	B
Cambridge Street and	Morning	0.66	15	B	0.65	15	B
Blossom Street/Garden Street	Evening	0.75	18	B	0.70	15	B
Cambridge Street and Joy Street	Morning	0.48	8	A	0.48	8	A
	Evening	0.57	8	A	0.55	8	A
Cambridge Street and	Morning	0.83	38	D	0.80	35	D
Stanford Street/Temple Street	Evening	0.84	48	D	0.81	43	D
Cambridge Street and	Morning	0.73	72	E	0.70	70	E
New Chardon Street/Bowdoin Street	Evening	0.98	56	E	0.81	50	D
Cambridge Street and	Morning	0.80	114	F	0.78	116	F
New Sudbury Street/Somerset Street	Evening	0.87	54	D	0.85	55	D

1 Volume-to-capacity ratio

2 Average delay expressed in seconds per vehicle

3 Level-of-Service

Table 2-5 Alternative 1 Unsignalized Intersection Traffic Operations

Intersection	Time of Day	Critical Movement	No Build Conditions			Alternative 1		
			v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS
Charles Circle – Cambridge Street/	Morning	SB T	0.88	67	F	0.77	45	E
Storrow Drive Westbound Off-Ramp	Evening	SB T	0.68	33	D	0.67	31	D
Cambridge Street and	Morning	SB R	0.28	25	C	0.30	27	C
North Anderson Street/ Anderson Street	Evening	SB R	>1.20	>120	F	>1.20	>120	F

1 Volume-to-capacity ratio

2 Average delay expressed in seconds per vehicle

4 Level-of-Service

2.2.2 Emergency Access and Truck Routes

There would be no long-term impacts to emergency access or truck routes in the Study Area. Construction related impacts are discussed in Chapter 3. There would be no long term impacts to the Partners Shuttle operation.

2.2.3 Pedestrians and Bicycles

The changes to pedestrian travel patterns that may be caused by the proposed Project were estimated using the CTPS travel demand model. These travel patterns can be found in Appendix A. Alternative 1 would modify pedestrian activity slightly in the vicinity of Bowdoin Station because the station would be closed under this alternative. Riders boarding or alighting at Bowdoin Station would use Government Center or Charles/MGH under Alternative 1.

Since pedestrian levels of service at crosswalks are a function of traffic signal timing and phasing and not of pedestrian volumes, pedestrian levels of service are expected to remain unchanged from the No-Build (and Existing) condition. However, there could be potential impacts to sidewalk capacity from the increase in pedestrians crossing Cambridge Street to Charles/MGH Station. The results of a sidewalk analysis (provided in Appendix A) indicate that adequate sidewalk space exists to accommodate the additional pedestrians who will cross Cambridge Street to/from the Charles/MGH Station.

No additional analysis was required at Government Center because the travel demand model shows that redistribution of pedestrian patterns would not include a higher number of pedestrians crossing Cambridge Street in this location.

Alternative 1 would not physically alter designated bicycle facilities nor disrupt future plans for either on-road or off-road facilities in the Study Area. Since the Charles/MGH Station is primarily accessed by foot, Alternative 1 is not expected to draw a substantial amount of new bicycle traffic to the area.

2.2.4 Parking

Alternative 1 would not physically alter the existing public parking supply or the City's ability to modify parking or change enforcement on a permanent or long-term basis.

2.2.5 Long-Term Mitigation

The proposed Project generally has minor, positive impacts on traffic operations. Therefore, no specific mitigation measures are required. However, the reduction of

through traffic along Cambridge Street may require minor traffic signal timing adjustments to reflect the slightly altered travel patterns.

2.3 Alternative 2

Alternative 2 includes extending the Blue Line to Charles/MGH Station and relocating the Bowdoin Station platform. Similar to Alternative 1, this alternative would require realigning the tracks from Government Center Station to Bowdoin Station and the construction of new tracks to Charles/MGH Station. Alternative 2 would also require a new subsurface platform for the Blue Line below and to the east of the Charles/MGH Station headhouse and pedestrian connections between the proposed Blue Line Station and the elevated Red Line platforms. Differing from Alternative 1, Bowdoin Station would be reconstructed under Alternative 2 to allow for greater transit access and would require the relocation of the eastbound platform to accommodate six-car trains. This relocation would occur at the station level only and the headhouse would remain in its existing location. As noted previously, there is a negligible difference in traffic operations when comparing Alternative 1 with Alternative 2. Therefore, in most cases the results are identical, as noted specifically in the following sections.

Table 2-6 presents the expected daily Red and Blue Line ridership under Alternative 2 (as compared to the No-Build). A detailed ridership discussion and analysis is provided in the *Ridership Technical Memorandum*.

Table 2-6 Projected Alternative 2 Station Activity

	No-Build (2030)			Alternative 2		
	Daily Boardings	Walk-Ins	Transfers	Daily Boardings	Walk-Ins	Transfers
Bowdoin Station	1,450	1,450	0	2,160	2,160	0
Charles/MGH Station	10,050	10,050	0	21,200	9,700	11,500
Red Line	10,050	10,050	0	13,650	7,900	5,750
Blue Line	No Service	No Service	No Service	7,550	1,800	5,750

Source: CTPS

2.3.1 Traffic Operations

Although ridership would differ slightly between Alternative 1 and Alternative 2, the expected decrease in traffic volume along Cambridge Street is the same under both alternatives. Since most riders access downtown stations by foot, the small changes in station activity between the two alternatives do not translate into a change

in traffic volume. The traffic impacts and benefits realized under Alternative 2 are identical to those of Alternative 1, as described above.

2.3.2 Emergency Access and Truck Routes

As with Alternative 1, there would be no long-term impacts to emergency access or truck routes to/from the Study Area.

2.3.3 Pedestrians and Bicycles

The change to pedestrian travel patterns that may be caused by the proposed Project was estimated using the CTPS travel demand model. These travel patterns can be found in Appendix A. Alternative 2 would increase pedestrian activity in the vicinity of Bowdoin Station due to the increased boardings. No other changes would be expected in the vicinity of Bowdoin or Government Center Stations.

Alternative 2 would not physically alter designated bicycle facilities nor disrupt future plans for either on-road or off-road facilities in the Study Area. Since both stations are within the central subway system and primarily accessed by foot, Alternative 2 is not expected to draw new bicycle traffic to the area.

2.3.4 Parking

Similar to Alternative 1, Alternative 2 would not physically alter existing public parking supply or the City's ability to modify parking or change enforcement on a permanent or long-term basis.

2.3.5 Long-Term Mitigation

The proposed Project generally has minor, positive impacts on traffic operations. Therefore, no specific mitigation measures are required. However, the reduction of through traffic along Cambridge Street may require minor traffic signal timing adjustments to reflect the slightly altered travel patterns.

3

Construction Impact Analysis

The following sections outline the proposed traffic management strategy for construction of the project. The proposed traffic management is identical regardless of whether Alternative 1 or Alternative 2 is progressed. The difference in construction of the two alternatives takes place below the street level and has no impact on the transportation infrastructure.

Construction impacts are expected to terminate when construction is complete, and usually consist of temporary road and sidewalk closures and detours. The transportation impacts of Alternative 1 and Alternative 2 are confined to short-term impacts to traffic/pedestrian circulation and parking that would occur during construction of the project. Roadway detours, moving construction equipment and the provision of work zones and support of excavation (SOE) areas would be limited to nights and weekends. A detailed discussion of construction staging is provided below, along with suggestions for mitigation of construction impacts.

3.1 Construction Impacts

The construction of Alternative 1 or 2 would include the following potential impacts. Existing station access to Charles/MGH Station would be maintained throughout construction. While Bowdoin Station would be closed during the majority of construction (either permanently or for reconstruction) there may be a need to provide access during early stages of construction (prior to the station being closed) via temporary sidewalks connecting to the existing headhouse. Impacts interior to the station are discussed in the *Construction Impacts Technical Report*.

3.1.1 Roadway Impacts

There would be no impact to the number of travel lanes provided along Cambridge Street during construction. Travel lanes would generally be 11 feet wide, with some turning lanes striped to 10 feet. Isolated impacts to intersection lane geometry would occur and are discussed in Section 3.1.3.

3.1.1.1 Parking

Eighty-nine parking spaces along Cambridge Street would be impacted at some point during construction. All but five of these spaces would only be impacted on a temporary basis. Table 3-1 presents the type, duration, and location of the parking impacts. The duration of impact would be further refined as the design for the Project is progressed.

For the duration of construction, the existing Massachusetts Eye and Ear Infirmary parking lot on Charles Street (under the Storrow Drive ramps) would be taken for use as a construction staging area. To accommodate Massachusetts Eye and Ear Infirmary patients and visitors who use this parking lot, a temporary multi-story parking structure would be constructed on the portion of the lot not used for construction staging.

Table 3-1 Construction-Related Parking Impacts

Location	Duration	Type	Associated with
Cambridge Street Westbound near Charles Circle	Duration of construction	5 meter	Mobilization/Staging, utility relocation, subsurface grouting and decking support construction
Cambridge Street Eastbound near Charles Circle	Construction Phase	4 meter 2 commercial	Mobilization/Staging, utility relocation, subsurface grouting and decking support construction
Cambridge Street Eastbound near North Anderson Street	Construction Phase	9 meter 1 loading zone	Vent room & egress hatch construction
Cambridge Street Westbound near North Anderson Street	Construction Phase	3 meter	Vent room & egress hatch construction
Cambridge Street Eastbound between Blossom Street and Hancock Street	Construction Phase	1 commercial	Median element construction
Cambridge Street Westbound between Hancock Street and Blossom Street	Construction Phase	7 meter	Median element construction
Cambridge Street Eastbound between Bowdoin Street and Court Street	Construction Phase	3 loading zone 21 meter 10 unrestricted	Slurry wall/utility relocation and decking construction
Cambridge Street Westbound between Bowdoin Street and Court Street	Construction Phase	14 meter 9 handicapped ¹	Slurry wall/utility relocation and decking construction

¹ An additional six handicapped parking spaces would be temporarily relocated from Cambridge Street to New Chardon Street.

3.1.2 Traffic Volumes

Disruptions to traffic that would be caused by construction of the proposed project are limited to night and weekend detours of portions of Cambridge Street. These detours are discussed in Section 3.2. Generally, Cambridge Street westbound traffic would be detoured to Leverett Circle via Staniford Street and Lomasney Way and eastbound traffic would be detoured to Blossom Street via Charles Street. Local access to streets and uses along Cambridge Street would be permitted under police control. Since detours would be limited to nights and weekends and through traffic would not be permitted into the study area during these times, the potential for traffic impacts in neighborhoods adjacent to Cambridge would be substantially reduced.

Traffic data collected during the overnight hours indicate that approximately 1,500 vehicles travel along Cambridge Street between the hours of 11:00 PM and 5:00 AM; the timeframe detours would be in place. The busiest of those hours is from 11:00 PM to 12:00 AM when 550 vehicles were observed. More than half of these vehicles travel in the westbound direction. This represents the maximum number of vehicles who have the potential to be detoured during construction.

At this phase of design (approximately 10 percent) it is not possible to determine the actual hours the detours would be in place or the duration of the detours. As design progresses, continuous modifications to the Traffic Management Plan would be required to incorporate the latest information.

3.1.3 Traffic Operations and Levels of Service

During construction, the geometry and/or signal timings at five intersections would be altered:

- Charles Circle – Charles Street/Storrow Drive Westbound Off-ramp
- Cambridge Street at Joy Street
- Cambridge Street at Staniford /Temple Street
- Cambridge Street at New Chardon/Bowdoin Street
- Cambridge Street at New Sudbury/Somerset Street

Anticipated changes to intersection level of service due to these construction modifications would be small (less than 10 seconds of additional delay) and isolated to particular movements at the intersections. The level of service analyses for the construction modifications are provided in the appendix.

Modifications at Charles Circle would be in effect throughout the entire construction period and include a reduction in the number of lanes provided in the northbound direction (under the Charles/MGH Station) from six lanes to three lanes.

Minor signal modifications would be implemented at the intersection of Cambridge Street at Joy Street during certain phases of construction. The crosswalk on the east side of this intersection would be moved approximately 35 feet east. To accommodate this shift, the clearance times (yellow and red signal indications) would be increased. The overall signal operations would not change and therefore no change in level of service is expected.

The traffic signal cycle length at the intersection of Cambridge Street at Staniford/Temple Street would be modified during the morning peak hour so that this intersection can remain part of a coordinated signal system with New Chardon and New Sudbury Streets. No other changes are proposed and this intersection would not see degradation in level of service due to this change.

The Cambridge Street intersections at New Chardon/Bowdoin Street and New Sudbury/Somerset Street would be altered for a large portion of the construction period. During this phase of construction, Cambridge Street would be reduced to two travel lanes plus a turning lane in both directions of travel between New Chardon Street and Court Street. Signal timing and phasing adjustments at the intersections of Cambridge Street and New Chardon/Bowdoin Street and Cambridge Street at New Sudbury/Somerset Street would be modified to accommodate this temporary traffic condition. Overall existing levels of service would be maintained at these intersections; however, some movements would experience an increase in delay due to construction. Traffic control would be managed through the use of police detail when necessary. A detailed discussion of the construction phasing is provided in Section 3.2.

Other temporary lane closures and detours would be required on occasion to facilitate moving equipment into and out of work zones and to support other construction measures. These lane closures and detours would occur at night and on weekends and are expected to have a limited impact on off-peak traffic operations. At nights and on weekends, New Sudbury Street would be temporarily closed at its intersection with Cambridge Street. Access to New Sudbury Street would be maintained from Congress Street.

3.1.3.1 Pedestrians and Bicycles

The maintenance of traffic through construction includes the maintenance of pedestrian and bicycle accommodations along the Cambridge Street corridor. There is one location where minor impacts to pedestrian accommodations would be unavoidable.

At the intersection of Cambridge Street at Joy Street, the pedestrian crosswalk across Cambridge Street would be moved to the east about 35 feet during a portion of construction. The current pedestrian signal crossing and traffic control would be

maintained and the delay to pedestrians waiting to cross the street would not change. For pedestrians heading to/from Charles River Plaza from Joy Street, the walk trip would increase by less than 10 seconds.

Minor signal timing adjustments at Staniford/Temple Street and New Chardon/Bowdoin Street would be needed throughout the duration of construction. These minor timing changes have a negligible effect on pedestrian levels of service at the intersection crosswalks.

3.1.4 Emergency Access and Truck Routes

Emergency access will be maintained at all times throughout the area. Temporary disruptions to emergency vehicles, the Partners Shuttle, and truck routes might occur during the closure and detour of Cambridge and Sudbury Streets on nights and weekends over the course of the project. At this stage of design, emergency access to the MGH/MEEI area when Cambridge Street westbound is closed would be via the closed section of Cambridge Street (emergency vehicles will be allowed access by police) to North Grove Street. When Cambridge Street eastbound is closed, access would be provided either from Charles Street, Blossom Street, and Parkman Street or via Revere Street to Garden Street, depending on which direction the emergency vehicle is coming from.

Access for the fire station would not be affected unless the unit is requested to assist the Cambridge Fire Department. If it is necessary for the fire unit to respond to an emergency in Cambridge while Cambridge Street westbound is closed, access would be provided via Lomansey Way and the Craigie (Charles River Dam) Bridge. This Access to Cambridge, Storrow Drive and Leverett Circle will also be available from the Cambridge Street fire house via Blossom Street to Charles Street.

As the design for the project develops and construction areas and associated detours are specifically defined, additional information on emergency access would be available. Close coordination with emergency response officials and area hospitals would be ongoing throughout design and construction to ensure all emergency responders have unimpeded access as needed. Section 3.2 provides additional information related to detour and trucking routes.

3.1.5 Transit Operations

As discussed above, changes to lane geometry at intersections would have a negligible impact to levels of service in the study area. No reduction in roadway cross-section along Cambridge Street is anticipated during peak hours and necessary road closures would occur during nights (mostly after MBTA service hours) and weekends. There are no existing or planned MBTA bus routes on Cambridge Street therefore no impacts are anticipated.

The traffic detours would cause small modifications to some Partners Shuttle routes during nights and weekends. The rerouting would not increase travel time for passengers.

3.2 Construction Impacts and Traffic Management Plan

This section summarizes the expected construction impacts on transportation and the Traffic Management Plan established in support of the conceptual design. At this stage of design, the plan maintains four lanes of traffic on Cambridge Street; maintains pedestrian access to businesses and transit; limits the removal of parking and loading zones; provides full and efficient access for emergency vehicles; and discourages cut-through traffic on surrounding neighborhood streets.

The Traffic Management Plan is still fairly general in nature at this stage of design and as the project design progresses, specific details related to time periods, number of days expected, and traffic volumes would be developed. The *Construction Impacts Technical Report* provides additional information on this subject.

3.2.1 Mobilization/Staging Area, Utility Relocation, Subsurface Grouting & Decking Support Construction

The initial phase of construction for Alternatives 1 and 2 starts with the relocation of utilities, subsurface jet grouting from the surface to stabilize soil conditions, and installation of the vertical traffic decking supports. This would also include the establishment of a construction staging area on the Massachusetts Eye and Ear Infirmary (MEEI) parking lot located between Storrow Drive eastbound and Charles Street. This staging area would comprise the area of land currently located between Storrow Drive eastbound and the north side base of the Longfellow Bridge. Initial work within this staging area would include the relocation of the existing driveway entrance further north to support the construction of a vertical shaft or “glory hole” within the footprint of the existing entrance driveway. The glory hole would extend down to track elevation at the westernmost terminus of the northern tail track to be constructed as part of this project. The glory hole would serve as the main connector to support tunnel construction for the entire western end of the project (areas west of New Chardon Street). All materials necessary for the construction of the tunnel structure, Tunnel Boring Machine (TBM), and excavation of the tunnels and station area would be serviced from this location.

Truck routes to and from the project areas are as defined on Figure 3-1. Charles Street north of Cambridge Street, Cambridge Street, and Lomasney Way are identified as truck routes in support of construction. While the work to construct the

glory hole would be completed outside of the public way, the work to relocate the entrance driveway, modify existing traffic alignments, complete necessary utility relocations, install vertical traffic decking supports, and subsurface grouting work would all take place within the public way. To accomplish these efforts, temporary lane closures and detours would be necessary. This work is planned to be completed during off-peak traffic hours as defined by the Boston Transportation Department. These hours are typically 9:30 AM to 3:30 PM and 7 PM to 5:30 AM Monday through Friday with weekend work and detours occurring between the hours of 7:00 PM on Friday evening and 5:30 AM on Monday morning. The use of full-time moving work areas along the parking lanes, sidewalks and in the existing medians would also be employed as necessary and as space allows within the Right-of-Way (ROW). Use of these full-time work areas and implementation of temporary lane closures and detours would have a localized affect on pedestrian routes, curbside parking and possibly roadway alignments depending on the size and location of the utility or vertical traffic decking support to be constructed. The exact nature and extent of these impacts would be discerned during final design of the proposed project.

3.2.2 Red Line Support, Support of Excavation (SOE), Vent Room Construction

Once the utility relocations have been completed, underpinning of the existing Red Line supports at Piers 6 and 7 along Cambridge Street eastbound would commence. To support this work, the existing Cambridge Street roadway would be realigned to the north as much as possible between these two supports to establish a work area around Pier 7 which is located on the southeastern side of Cambridge Street eastbound (see Figure 3-2). The work area would comprise part of the existing private parking lot located beneath the Red Line tracks east of Pier 7. This area is necessary to not only construct the underpinning system for Pier 7 and vertical traffic decking support elements but also to accommodate the relocated pedestrian walkway around the work area during this phase of construction.

Cambridge Street eastbound would remain a two-lane roadway widening to a three-lane roadway as it approaches North Grove Street (as it exists today). Cambridge Street westbound would be realigned to the north into the existing parking lane (to the west of Cambridge Street Avenue) with a two lane section replacing the current three lane section as it approaches the existing traffic signal at Charles Street. Access would be maintained to/from West Cedar Street, Lindall Place and the parking lot driveway adjacent to the proposed work area at all times.

The realignment of Cambridge Street would also include modifications within Charles Circle. The easternmost roadway beneath the Charles/MGH Station accessing Charles Street would be closed and traffic shifted to the center roadway beneath the station that currently provides access only to Storrow Drive westbound and the MEEI parking area. This would require modifications to the existing traffic signal and median island separating the Storrow Drive westbound on-ramp from

Charles Street to accommodate the movement to Charles Street from this location. This change would also require a modification to the existing median between the Longfellow Bridge eastbound and the Storrow Drive westbound off-ramp providing access to Charles Circle. The closed roadway within Charles Circle would be used as a staging area to support the station modification work necessary to incorporate the new Blue Line station below grade into the existing elevated Red Line station.

As shown on Figure 3-3, to support construction east of New Chardon Street, Cambridge Street would be realigned to the south between New Chardon and Court Streets to establish full-time work zones on the north side of Cambridge Street. This is to support the modifications necessary to the existing Bowdoin Station, utility relocation, vertical traffic decking support installation, and installation of an earth retention system to support excavation (SOE) for the cut and cover construction section of the project. The realigned roadway would consist of two general purpose lanes in each direction of travel with additional exclusive left-turn lanes for the intersecting side streets at both New Sudbury and Somerset Streets. Parking would be maintained on both sides of the alignment with limited temporary prohibitions to support ongoing construction.

Once the utility relocation, vertical traffic decking support installation and earth retention systems are completed, Cambridge Street would be realigned to the north between New Chardon and Court Streets to establish full-time work zones on the south and center portions of Cambridge Street, as shown on Figure 3-4. This is to support utility relocation, vertical traffic decking support installation, and installation of an earth retention system to support excavation (SOE) for the remainder of the cut and cover construction section of the project. The realigned roadway would consist of two general purpose lanes in each direction of travel with additional exclusive left-turn lanes for the intersecting side streets at both New Sudbury and Somerset Streets. Parking would be restricted on both sides of the alignment for the duration of work through this area.

Once the construction in the area of Pier 7 is complete, Cambridge Street eastbound would be realigned to the south between Charles Street southbound and Lindall Place to establish a larger work area adjacent to the Charles/MGH station for the underpinning, demolition and reconstruction of Pier 6, and other associated work (Figure 3-5). The new alignment would remain a two-lane roadway widening to a three-lane roadway as it approaches North Grove. This traffic pattern change would affect only Cambridge Street eastbound and maintains the previously established alignments within Charles Circle and along Cambridge Street westbound. This long term work area and roadway alignment would remain in place until the beginning of surface restoration in the final phases of construction.

3.2.3 Traffic Decking

Figure 3-6 shows the proposed detours associated with the installation of traffic decking. As the installation of the vertical traffic decking supports advances, traffic decking excavation and installation would begin. In order to facilitate this work, Cambridge Street would be closed and detoured in certain locations and temporarily realigned in others. Traffic decking across the Charles/MGH section of Cambridge Street would be completed in two sections (north and south sections) due to utility relocations necessary to complete this work.

The first or north section of traffic decking to be installed would require the closure and detour of Cambridge Street westbound. This is necessary to excavate out the existing roadway and subgrade material and install the horizontal decking supports and traffic decking system in sections. This work is planned to be completed utilizing weekend detours. Cambridge Street eastbound would remain open to traffic with Cambridge Street westbound closed to general traffic at Staniford Street. Where Cambridge Street would be closed, local access to abutting properties and the medical facility area would be allowed via North Grove Street. The detour for general traffic would be:

- Right-turn (north) to Staniford Street.
- Left to Lomasney Way (which becomes Nashua Street) with access to Leverett Circle.
- From Leverett Circle, traffic destined for Charles Circle and Cambridge would be directed right onto O'Brien Highway and then left onto Land Boulevard.
- Traffic destined for Charles Circle would then be directed eastbound across the Longfellow Bridge back to Charles Circle.
- Traffic destined for Cambridge would be directed to Broadway in Cambridge via Land Boulevard.

Traffic decking installation for the south section across Cambridge Street eastbound would be completed in the same manner. Cambridge Street westbound would remain open to traffic and Cambridge Street eastbound would be closed to all traffic at Charles Circle. The detour for general traffic would be:

- Charles Circle to Charles Street northbound.
- Right-turn onto Blossom Street.
- Blossom Street back to Cambridge Street.

Access to Lindall Place would be maintained using police control on the closed section of Cambridge Street. The section of West Cedar Street north of Phillips Street would be closed except for local access.

Traffic decking would also be installed over the cut and cover section east of New Chardon Street. Installation of decking through this area would require the

implementation of a unique traffic pattern. This traffic pattern would allow for the maintenance of two-way traffic and limited parking with traffic being temporarily rerouted around the areas to be installed within Cambridge Street. This work would take place during off-peak traffic hours at night and on weekends to limit disruption.

There would also be a need to temporarily close and detour New Sudbury Street traffic to New Chardon Street to support the construction through this area also during off-peak traffic hours at night and on weekends. Local access to New Sudbury Street would be maintained from Congress Street under police control. As shown on Figure 3-7, once the traffic decking installation is completed, the traveled way would be realigned between New Chardon and New Sudbury Streets to provide a center work area to advance the tunnel construction work below the traffic decking.

3.2.4 Tunnel Boring Machine (TBM) Installation/Extraction

The installation of traffic decking allows for construction to continue below grade without disruption to traffic above. However, Cambridge Street traffic in the Charles/MGH area would be closed and detoured for two additional weekends to temporarily remove the traffic decking and install and assemble the TBM and reinstall the traffic decking to excavate the north and then the south tunnels of the new Blue Line connector. The area of impact would be the same as it was for the traffic decking installation and therefore the local access and detours would also be the same as shown on Figure 3-6.

The same process would take place where the TBM terminates its excavation work in the New Chardon Street Area for both the north and south tunnels. The implementation of a unique traffic pattern, maintaining two-way traffic with one lane for each direction of travel, would be necessary over a weekend period to temporarily remove the traffic decking, disassemble and remove the TBM and reinstall the traffic decking. Access would be maintained to/from Bowdoin, New Chardon and New Sudbury Street at all times for this element of the work.

3.2.5 Median Element Construction

The final stages of construction, prior to final surface street restoration, would involve the construction of elements in two areas of the project corridor within the existing median islands along Cambridge Street. To allow for the construction of these elements, traffic would be realigned to provide a work area along or staged across the existing median. The first area is located between North Grove and North Anderson Streets to construct an emergency egress walkway, hatch and ventilation fan room from the new Blue Line station platform up to the roadway surface. To accomplish this, curbside parking restrictions and curb modifications on Cambridge Street eastbound and westbound between North Grove and Blossom Streets as well

as modifications to the existing signal phasing and timing at the intersection of Cambridge and Blossom Streets would be necessary. Implementation of this staged construction will also require the temporary removal of existing Cambridge Street eastbound left turn lane approaching Blossom Street for the duration of this work as shown on Figures 3-8, 3-9 and 3-10.

The second area would be located at Joy Street in the vicinity of the West End Branch of the Boston Public Library and the Beacon Hill/West End Firehouse. The second area would only be required for the construction of Alternative 2. As shown on Figure 3-11, establishing this median work area would require curb line modifications, parking restrictions and pedestrian/traffic signal modifications on Cambridge Street. The work area as currently planned would not inhibit access to/from the firehouse or any of the adjacent properties at any time. It would require the temporary relocation of the existing Joy Street pedestrian crossing and associated traffic signal equipment approximately 35 feet to the east of its current location for the duration of this work zone.

3.2.6 Surface Restoration

Cambridge Street would need to be closed and detours would also be necessary a number of times near the end of construction to remove the traffic decking, backfill over the newly completed tunnel structures and begin surface restoration work. Once the removal of the traffic decking and final utility installation has been completed, roadway configurations would return to their respective pre-construction alignments and surface restoration work would be completed using temporary lane closures or detours during off-peak traffic periods to complete the work.

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Figures

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